at least two layers of material, each layer having a length, width and thickness dimension, wherein at least one layer is an electroactive material and wherein at least one layer is of non-uniform thickness; and

means for bonding the layers to one another;

wherein the cross-section of at least one non-uniform layer is defined by a function of both the distance along the length of the layer and the distance along the width of the layer.

REMARKS

Claims 1-36 remain pending in this application. Claims 1-9, 11-15, 17, and 20-36 are rejected. Claims 10, 16, 18 and 19 are objected to. The Drawings have been objected to. Applicants have added a drawing, and amended the specification and claims 1, 6, 10, 16, 18 and 19.

Objection under 37 C.F.R. 1.83(a)

The Examiner has objected to the drawings under 37 CFR 1.83(a). Specifically, the Examiner has stated that the non-uniform thickness dependence on the (1) width and the (2) width and length must be shown or the feature(s) canceled from the claim(s). Applicants have added FIG. 6 to illustrate these features. Such addition is supported by the specification at page 9, lines 25-30. Corresponding amendments have been made to the specification at page 25 (3 above) and "Brief Description of the Drawings" (4 above).

Rejection under 35 U.S.C. 102

The Examiner rejected claims 1-3, 5-9, 11-14, 17, 20-23, 25-27, and 30-33 under 35 U.S.C. 102(b) as being anticipated by *Schafft* (U.S. Patent 3,676,722). The Examiner stated that:

(1) with respect to claims 1 and 21-22: *Schafft*, in FIG. 3, discloses an electroactive device comprising two layers of material with layer 42 of non-uniform thickness, and *Schafft* discloses the use of a conductive epoxy;
(2) with respect to claims 2, 3, and 14: *Schafft* discloses electrical signal 54;
(3) with respect to claim 5, it is an inherent property of electroactive devices that the amplitude controls the range of motion;
(4) with respect to claims 6-8, the non-uniform thickness layer inherently has these properties;
(5) with respect to claims 9 and 17, FIG. 3 of *Schafft* discloses that the non-uniform thickness is a function of length;
(6) with respect to claim 11, *Schafft* discloses two electroactive layers in FIG. 3;
(7) with respect to claims 12 and 13, *Schafft* discloses the use of a conductive epoxy;
(8) with respect to claim 20, no structural limitations are added in this claim; and
(9) with respect to claims 23, 25-27 and 30-33, the *Schafft* discloses that the electroactive device is used for loudspeaker as disclosed in FIG. 4.

Applicants have amended claim 1 to add the limitation "wherein at least one layer of electroactive material is of non-uniform thickness". Applicants respectfully assert that *Schafft* does not disclose this limitation. FIG. 3 of *Schafft* illustrates two constant thickness electroactive layers and one non-uniform thickness layer 42 of non-electroactive material. Furthermore, *Schafft* teaches (see specification at Column 4, lines 33-67), non-uniform thickness of only the non-electroactive layer.

Applicants respectfully assert that the amendment to claim 1 places it in condition for allowance, and that claims 2-3, 5-9, 11-14, 17, 20-23, 25-27, and 30-33 that depend therefrom are, therefore, also in condition for allowance.

Rejection under 35 U.S.C. 103

Claims 4, 15, 24, 28, 29 and 34-35 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Schafft* in view of *Pelrine et al.* The Examiner stated that:

(1) with respect to claim 4, *Schafft* discloses in FIG. 3 an electroactive device comprising two layers of material with layer 42 of non-uniform thickness and discloses means for bonding;

(2) *Schafft* does not disclose polymer electrodes;

(3) *Pelrine et al.* disclose polymer electrodes in the last full paragraph on page 240 for the purpose of providing compliant electrical connections;

(4) it would have been obvious to one of ordinary skill in the art to use the polymer electrodes of *Pelrine et al.* in the device of *Schafft* for the purpose of providing compliant electrical connections;

(5) with respect to claim 15, *Schafft* does not disclose what type of material is being used;

(6) Examiner takes official notice that polymers, ceramics, and composites would have been well known, that the court has found that the selection of a known material based on its suitability for its intended use is obvious, and that it would have been obvious of one of ordinary skill in the art to use polymers, ceramics, and composites for the purpose of utilizing their well documented properties;

(7) with respect to claims 24, 28, and 29, *Schafft* only discloses the device of use in a speaker;

(8) Examiner takes official notice that reflectors and display panels would have been well known, that *Schafft* does not indicate that the non-uniform thickness makes the electroactive device stronger, but it would have been obvious to one of ordinary skill in the art to use the device of *Schafft* in a reflector or a display panel for purpose of providing an actuator with increased strength;

(9) with respect to claims 34 and 35, *Schafft* does not disclose the same scale;

(10) *Schafft* does indicate that the non-uniform thickness makes the electroactive device stronger and it would have been obvious to one of ordinary skill in the art to scale down the device of FIG. 3 of *Schafft* for the purpose of providing micro and nano-scale device with improved strength.

Applicants respectfully assert that, as a result of the amendment to claim 1 to add the limitation of at least one layer of electroactive material of non-uniform thickness, claims 4, 15, 24, 28, 29, and 34-35 are novel and non-obvious in view of the cited art and are, therefore, in condition for allowance.

Allowable Subject Matter

The Examiner stated that claims 10, 16, 18, and 19 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Applicants have amended claims 10, 16, 18 and 19 accordingly and thus assert that such claims are now in condition for allowance.

Additional Amendments

Applicants have amended: the specification to update filing information for related cases (see **(1)** and **(2)** above); the specification at page 25 to remove a partial sentence typographical error (see **(3)** above); claims 1, 10, 16, 18 and 19 to replace a semicolon with a comma; and the specification at page 5 to change a reference from plural FIGs. to singular FIG (see **(4)** above).

Attached hereto is a marked-up version of the changes made to the specification. The attached page is captured **"Version with Markings to Show Changes Made."**

CONCLUSION

In view of the above amendments and remarks, it is submitted that instant claims 1-36 are in condition for allowance. Reconsideration and withdrawal of the objections and rejections is requested and allowance of the claims at an early date is solicited.

Respectfully submitted,

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Version with Markings to Show Changes Made

In the Drawings:

FIG. 6, attached hereto, has been added.

In the Specification:

The Cross Reference to Related Cases paragraph beginning at page 1, line 11, has been replaced with the following rewritten paragraph:

This application is related to co-pending, commonly owned patent application Serial No. ~~_____~~ 09/696,524, filed October 23, 2000, entitled "Polymer-Polymer Bilayer Actuator", co-pending commonly owned patent application Serial No. ~~_____~~ 09/696,528, filed October 23, 2000, entitled "Electrostrictive Graft Elastomers," and co-pending, commonly owned patent application Serial No. ~~_____~~ 09/696,527, filed October 23,2000, entitled "Membrane Position Control."

The paragraph beginning at page 3, line 1, has been replaced with the following rewritten paragraph:

Electrostrictive polymer-polymer actuators or other electroactive polymer actuators that provide enhanced strain capabilities can shape, tune, position, control and deform membrane structures, as well as perform in other applications, in ways not previously possible with other materials. An example of such an electrostrictive polymer-polymer actuator is described in the patent application entitled "Polymer-Polymer Bilayer Actuator", Serial No. ~~_____~~ 09/696,524, filed October 23, 2000, hereby incorporated by reference. The greater strain capability provides further possibilities for small-scale applications and integration into skin surfaces. The

electroactive actuators can coincide with specific contours to optimize, for example, shapes for fluid flow, reflection and other membrane uses.

The paragraph beginning at page 9, line 25, has been replaced with the following rewritten paragraph:

Referring now to FIG. 6, the ~~The~~ thickness variation of one or more layers is chosen to achieve a desired contour. The thickness of a layer can vary as any function of length (t=f(l)), any function of width (t=f(w)), or as any function of both length and width (t=f(l,w)). This thickness variation acts in cooperation with and/or enhances the contour that could be achieved by material choice, electrode design, or orientation of layers. ~~The electroactive device~~

The Brief Description of the Drawings paragraph beginning at page 5, line 15, has been replaced with the following rewritten paragraph:

A more complete appreciation of the invention and the many of the attendant advantages thereof will be readily attained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIGs. 1A illustrates a side view of an embodiment of a non-uniform thickness actuator, showing the most responsive portions located at the thinnest points of the active layer closer to the free end.

FIG. 1B illustrates a side view of an embodiment of a non-uniform thickness actuator, showing the most responsive portions located at the thinnest points of the active layer closer to the cantilevered end.

FIG. 2 illustrates a side view of a non-uniform thickness actuator fixed at one end, with the thickness of the active layer decreasing towards the fixed ends.

FIGs. 3A-3C illustrate a cross section of a typical hydrofoil or airfoil with a non-uniform thickness actuator, in actuated and non-actuated configurations, attached to the surface of the foil.

FIG. 3D illustrates a cross section of a typical hydrofoil or airfoil with a non-uniform thickness actuator integrated into the foil.

FIG. 4 illustrates an embodiment of a non-uniform thickness actuator having stacked electroactive layers, wherein the stacks on either side of the bond interface are alternately activated.

FIG. 5 illustrates an embodiment of a non-uniform thickness actuator having multiple electroactive layers.

FIG. 6 illustrates thickness variation of a single layer of an actuator.

Claims 1, 6, 10, 16, 18 and 19, have been amended as follows:

1. (Amended) An electroactive device, comprising:

at least two layers of material, each layer having a length, width and thickness dimension, wherein at least one layer is an electroactive material and wherein at least one layer of electroactive material is of non-uniform thickness; and

means for bonding the layers to one another.

6. (Amended) The electroactive device of claim 1, wherein ~~the at least one~~ non-uniform thickness of at least one layer enables a controlled contouring of the activated device.

10. (Amended) ~~The electroactive device of claim 1,~~ An electroactive device, comprising:

at least two layers of material, each layer having a length, width and thickness dimension, wherein at least one layer is an electroactive material and wherein at least one layer is of non-uniform thickness; and

means for bonding the layers to one another;

wherein the non-uniform thickness of at least one layer is a function of both the length and width of the layer.

16. (Amended) ~~The electroactive device of claim 1,~~ An electroactive device, comprising:

at least two layers of material, each layer having a length, width and thickness dimension, wherein at least one layer is an electroactive material and wherein at least one layer is of non-uniform thickness; and

means for bonding the layers to one another;

wherein the electroactive material is an electrostrictive graft elastomer comprising a backbone molecule which is a non-crystallizable, flexible macromolecular chain, and a grafted polymer forming polar graft moieties with backbone molecules, the polar graft moieties having been rotated by an applied electric field and sustained in the rotated state until the electric field is removed.

18. (Amended) ~~The electroactive device of claim 1,~~ An electroactive device, comprising:

at least two layers of material, each layer having a length, width and thickness dimension, wherein at least one layer is an electroactive material and wherein at least one layer is of non-uniform thickness; and

means for bonding the layers to one another;

wherein the cross-section of at least one non-uniform layer is defined by a function of the distance along the width of the layer.

19. (Amended) ~~The electroactive device of claim 1,~~ An electroactive device, comprising:

at least two layers of material, each layer having a length, width and thickness dimension, wherein at least one layer is an electroactive material and wherein at least one layer is of non-uniform thickness; and

means for bonding the layers to one another;.

wherein the cross-section of at least one non-uniform layer is defined by a function of both the distance along the length of the layer and the distance along the width of the layer.